Mechanical Equipment Design 21/12/16

SE | IV | CBSGS | Chem | MED

(31) **Q.P. Code : 573303**

(4 Hours) **[Total Marks : 80**

N.B. : (1) Question **No.1** is **Compulsory.**
(2) Attempt **any four** questions out of remaining **six** questions.
(3) Assume any suitable data if necessary and indicate it clearly.

1. Write short notes on **any four** of the following :- **20**
   (a) Design stress & Factor of Safety.
   (b) Theories of failure.
   (c) Standards, Codes and their significance.
   (d) Choice and selection of material of fabrication for Process Equipment.
   (e) Storage of volatile liquids and gasses

2. (a) Design a pressure vessel for the following specification/data: **15**
   (i) Shell :
   Internal Diameter = 1200 mm
   Material = Carbon steel (IS 2002)-(CS)
   Permissiblc stress for CS at 150° C =105N/mm²
   Internal pressure = 0.6 N/mm²
   (ii) Head : (Standard Torispherical)
   Crown radius =1200 mm
   Knuckle radius = 10% of Crown radius.
   Material = CS
   (iii) Flanges:
   Material = CS
   Gasket = Asbestos filled soft alluminium material
   Gasket factor (m) = 3.25
   Minimum design seating stress = 38 N/mm²
   (iv) Bolts :
   Material = Hot rolled carbon steel with Permissible stress = 54.5 N/mm².
   The design should consists of the following :
   (i) Shell (ii) Head and (iii) Flanges

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2. (b) Draw proportionate diagram of above mentioned pressure vessel, show : 5
   (i) Sectional Front View
   (ii) Top View

3. (a) Give detailed design procedure with equations for large storage vessels. 14
   It should include
   (a) Bottom design (b) Shell plates (c) Top Roof design

   (b) Draw proportionate diagrams of: 6
   (i) Arrangement of shell plates
   (ii) Arrangement of sketch and annular plate of storage vessel

4. (a) A turbine agitator is to be designed for the following data :- 15

Vessel diameter	:	1200 mm
Diarneter of Agitator	:	400 mm
Maximum speed	:	200 mm
Specific gravity of liquid in the vessel	:	1.8
Viscosity of liquid in vessel	:	600 CP
Overhang of Agitator	:	800 mm
Number of Blades	:	6
Width or Blades	:	70 mm
Thickness of Blades	:	8mm
Shear stress in shaft	:	50 N/mm^2
Elastic limit (Tensile)	:	250×10^6 N/m^2
Modulus of elasticity	:	2×10^5 N/mm^2
Permissible shear stress in key	:	50 N/mm^2
Allowable crushing stress in key	:	100 N/mm^2
Stress in stuffing box	:	95 N/mm^2
Permissible stress in studs (Tensile)	:	60 N/mm^2
Shear stress allowed in coupling bolts	:	30 N/mm^2
Allowable shear stress in coupling tlange	:	15 N/mm^2
Power number	:	4
Gland Losses	:	10%
Transmission losses	:	15%
Internal pressure in vessel	:	0.5 N/mm^2
Baffles	:	4 (At Tank Wall)

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Design the following :-

(i) Agitator shaft design

(ii) Blades Design

(iii) Flange coupling.

(iv) Stuffing box assembly.

(b) Draw to a recommended scale, Front View & Top View of Agitator assembly. **5**

5. (a) Describe the design procedure for reaction vessel with - **10**

(i) Plain Jacket

(ii) Half Coil Jacket

(b) Describe the design procedure for Skirt support for a vertical cylindrical vessel with necessary equations. **10**

20

6. Write short notes on **any four** of the following :-

(i) Baffles in agitation system.

(ii) Radiographic testing of pressure vessels.

(iii) Types of Heads.

(iv) Saddle support.

(v) Types of flanges.
